1987-220

LAKE LANDFILL

EMISSIONS ANALYSIS FROM FLARE COMBUSTION

A. INLET CONDITIONS

Gas Concentration:

Methane	60%
Carbon Dioxide	40%
Non-methane Hydrocarbons	203 ppm
Sulfur Compounds	47 ppm

Gas Flow $4x10^6$ CFD

B. EMISSIONS CALCULATIONS

Assumptions:

1. Methane combusion efficiency of 99.8 minimum is assumed.*
2. 95% combustion efficiency is assumed for trace hydrocarbons.
3. Unburned methane is assumed to produce carbon monoxide.
4. Balanced equations for 1 & 2 above are:

   a. $CH_4 + CO_2 + 2O_2 + 7.5N_2 \rightarrow 2CO_2 + 2H_2O + 7.5N_2$

   b. $CH_4 + CO_2 + 3/2O_2 + 5.6N_2 \rightarrow CO + 2H_2 + 5.6N_2$

Mass Calculation: (#/day)

Mass calculations were determined using the following equation:

#/day = (inlet concentration) x (gas density) x (flow)

Gas densities are at 60°F and 760 millimeters Hg pressure.
Gas concentrations are based on typical landfill gas analysis.
Flow is based on maximum capacity at the flare station of $4.0x10^6$ cfd.

Component:/Mass Calculation

CH_4: (.60) (.0423#/CF) ($4x10^6$CFD) = $1.01x10^5$#/day

CO_2: (.40) (.1140#/CF) ($4x10^6$CFD) = $1.82x10^5$#/day

Sulfur: ($4.7x10^{-5}$) (.20#/CF) ($4x10^6$CFD) = 37.6#/day

Hydrocarbons: (2.10^{-4}) (.2271#/CF) ($4x10^6$CFD) = 181.6#/day

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Combustion Analysis

$$CO_2: \frac{(.9983)\ (1.01x10^5\#/d\ CH_4)}{16\ (\text{mol wt. of } CH_4)} = \frac{2CO_2\#/d}{44\ (\text{mol wt. of } CO_2)}$$

$$= 1.39x10^5\#/day\ CO_2$$

$$H_2O: \frac{(.99)\ (1.01x10^5\#/d\ CH_4)}{16\ (\text{mol wt. of } CH_4)} = \frac{2H_2O\#/d}{18\ (\text{mol wt. of } H_2O)}$$

$$= 5.62x10^4\#/day\ H_2O$$

* Based on a report prepared for the Chemical Manufacturers Association and USEPA entitled: "A Report On A Flare Efficiency Study, March, 1983."

$$CO: \frac{(.0017)\ (1.01 \times 10^5\#/d\ CH_4)}{16\ (\text{mol wt. of } CH_4)} = \frac{CO\#/d}{28\ (\text{mol wt. of CO})}$$

$$= 3 \times 10^2\#CO/day$$

$$SO_2: \frac{37.6\#/day\ \text{Sulfur}}{50\ (\text{avg. mol wt.})\ (\text{of Sulfur cmpds})} = \frac{SO_2/day}{64\ (\text{mol wt. } SO_2)}$$

$$= 48\#/day\ SO_2$$

Hydrocarbons: (.05) (181.6#/d) = 9.1#/day

CH_4: (.0017) $(1.01 \times 10^5\#/day)$ = 171.7#/day

C. EMISSIONS SUMMARY

Component	#/Day	Tons/Year
CO_2	1.39×10^5	25,367
CO	3×10^2	54.75
H_2O	5.62×10^4	10,256
SO_2	48	8.7
HC	9.1	1.66
Methane	171.7	31.33